SECTION 16726

PUBLIC ADDRESS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Equipment for interface to telephone system amplifying, distribution, and reproducing sound signals, both speech and tones.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 16111, Conduit and Fittings.
   2. Section 16450, Grounding.
   3. Section 16715, Premises Telephone Wiring.

1.3 DEFINITIONS

A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

B. Zone: A separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

C. VU: Volume unit.

1.4 REFERENCES

A. Electronic Industries Association (EIA):
   1. EIA SE-101-A, Amplifiers for Sound Equipment.
   2. EIA SE-103, Speakers for Sound Equipment.
   3. EIA-105, Microphones for Sound Equipment.
   4. EIA-160, Sound Systems.
   5. EIA-310D, Cabinets, Racks, Panels, and Associated Equipment.

B. Underwriters Laboratories, Inc., (UL):
   1. UL 50, Enclosures for Electrical Equipment.

C. National Fire Protection Association (NFPA):
   1. NFPA 70-1999, National Electrical Code (NEC).

1.5 PERFORMANCE REQUIREMENTS

A. System Functions: Include the following:
   1. Selectively connecting separate zones to different signal channels.
   2. Selectively amplifying sound among various microphone outlets and telephone system interface inputs.
   3. Communicating simultaneously to all zones regardless of zone or channel switch settings.

4. Paging, by dialing an extension from any local telephone instrument and speaking into the telephone.
5. Producing a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
6. Reproducing high-quality sound that is free from noise and distortion at all loudspeakers at all times during equipment operation, including standby mode with inputs off; and output free from nonuniform coverage of amplified sound.

1.6 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and General and Supplementary Conditions.

B. Product Data: For each type of equipment

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.
1. Console layouts.
2. Control panels.
3. Rack arrangements.
4. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components.

D. Product Certificates: Signed by manufacturers of equipment certifying that products furnished comply with specified requirements.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

F. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

G. Coordination Drawings: Provide layout coordinated with the installation of other electrical equipment and the equipment provided under architecture and mechanical trades.

H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

I. Maintenance Data: For equipment to include in maintenance manuals specified in general conditions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to CM.

C. Comply with NFPA 70.

D. Comply with UL 50.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in factory-packaged components with protective crating and covering.

B. Store equipment in air-conditioned and heated space prior to installation.

C. Handle equipment carefully so as to prevent damage during installation.

1.9 SEQUENCING, SCHEDULING AND COORDINATION

A. Coordinate location of equipment supporting means prior to installation.

B. Schedule installation of equipment so as to prevent damage to components from construction activities.

C. Coordinate interface with telephone system with telephone system supplier.

1.10 OCCUPANCY ADJUSTMENTS

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions. Provide up to three on-site assistance visits within one year of Substantial Completion. Each visit shall be of such duration so as to inspect each sound producing device and amplifier and make necessary adjustments.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Altec Lansing/University Sound.
   2. Atlas-Soundolier; Atapco Security & Communications Group.
   3. Bogen Communications, Inc.
   4. Dukane Corp.; Communications Systems Div.
   5. Electro-Voice, Inc.
   6. Rauland-Borg Corp.

2.2 EQUIPMENT

A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Modular type, using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.3 PREAMPLIFIERS

A. Comply with EIA SE-101-A; either separately mounted or as an integral part of power amplifier.

B. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.

C. Total Harmonic Distortion: Less than 1 percent.

D. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

E. Input Jacks: Minimum of three. One matched for low-impedance microphone; one matchable to cassette deck, CD player, or radio tuner signals without external adapters, and one matchable to telephone system output.

F. Minimum Noise Level: Minus 55 dB below rated output.

G. Controls: On/off, input levels, and master gain.

2.4 POWER AMPLIFIERS

A. Comply with EIA SE-101-A.

B. Mounting: Rack mounted.

C. Output Power: 100-W balanced line.

D. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

E. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

F. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.

G. Output Regulation: Less than 2 dB from full to no load.

H. Controls: On/off, input levels, and low-cut filter.

I. Input Sensitivity: Matched to preamplifier and providing full-rated output with a sound-pressure level of less than 10 dynes/sq. cm impinging on a speaker microphone or hand-set transmitter.

2.5 COMPONENTS

A. Microphone: Comply with EIA SE-105.
   1. Type: Dynamic, with cardioid polar or omnidirectional characteristic.
   2. Impedance: 150 ohms.
   3. Frequency Response: Uniform, 60 to 12,000 Hz.
   4. Output Level: Minus 58 dB minimum.
   5. Finish: Satin chrome.
   6. Mounting: Desk stand with integral-locking, press-to-talk switch.
   7. Quantity of Microphones: Four, including one spare.
   8. Quantity of Desk Stands: Three.

B. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
   1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.
   2. Signal Reduction Ratio: At least a 10:1 and 5:1 selectable capability.
   3. Distortion: 1 percent, maximum.
   4. Rated Output: Minimum of plus 14 dB.
   5. Inputs: Minimum of two inputs with variable front-panel gain controls and a VU or dB meter for input adjustment.

C. Telephone Paging Adapter: Arranged to accept voice signals from telephone extension dialing access and to automatically provide amplifier input and program override for pre-selected zones.
   1. Minimum Frequency Response: Flat, 200 to 2,500 Hz.
   2. Impedance Matching: Adapter matches telephone line to public address equipment input.

D. Tone Generator: For clock and program interface.
   1. Signals Produced: Minimum of seven distinct, audible signal types, including wail, warble, high/low, alarm, repeating chimes, single-stroke chime, and tone.
   2. Pitch Control: Chimes and tone.
   3. Volume Control: All outputs.
   4. Activation-Switch Network: Establishes priority and hierarchy of output signals produced by different activation setups.

E. Cone-Type Loudspeakers: Comply with EIA SE-103.
   1. Minimum Axial Sensitivity: EIA pressure rating of 45 dB.
   2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
   3. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet.
   4. Minimum Dispersion Angle: 100 degrees.
   5. Rated Output Level: 10 W, 110 db(A) at 10 feet.
   6. Matching Transformer: Comply with EIA-160. Full-power rated with four EIA standard taps. Maximum insertion loss of 0.5 dB.
   7. Surface-Mounting Units: Ceiling, wall, or pendant mounting, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and shop primed for field painting.
   8. Flush-Ceiling Mounting Units: In steel back boxes, acoustically dampened. Metal ceiling grille with baked, white-enamel finish.
   9. Provide screw driver-operated volume control on each speaker accessible through speaker grille.

F. Horn-Type Loudspeakers: Comply with EIA SE-103.
   1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W, 110 db(A) at 10 feet.
   2. Matching Transformer: Comply with EIA-160. Full-power rated with four EIA standard taps. Maximum insertion loss of 0.5 dB.
   3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
   4. Dispersion Angle: 130 by 110 degrees.
   5. Mounting: Integral bracket.
   6. Units in Hazardous (Classified) Locations: Listed and labeled for the environment in which they are located.

G. Noise-Operated Gain Controller: Units continuously sense space noise level and automatically adjust signal level to local speakers.
   1. Frequency Response: 20 to 20,000 Hz, plus or minus 1 dB.
   2. Level Adjustment Range: 20 dB minimum.

3. Maximum Distorsion: 1 percent.
4. Control: Permits adjustment of sensing level of device.

H. Volume Attenuator Stations: Wall-plate-mounted autotransformer type with paging priority feature.
1. Wattage Rating: 10 W, unless otherwise indicated.
2. Attenuation per Step: 3 dB, with positive off position.
3. Insertion Loss: 0.4 dB maximum.
4. Attenuation Bypass Relay: Single pole, double throw. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
5. Label: “PA Volume.”

I. Microphone Outlets: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with a brushed stainless-steel device plate. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

J. Cable and Conductors: Jacketed, twisted-pair and twisted-multipair, untinned, solid-copper conductors.
1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
3. Plenum Cable: Listed and labeled for plenum installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for equipment supports to verify actual locations and sizes and types of supports match those indicated, before equipment installation.

B. Examine walls, floors, and locations for suitable conditions where equipment is to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment to comply with manufacturer’s written instructions.

B. Wiring Method: Install wiring in raceway. Conceal cable and raceway except in unfinished spaces.

C. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cable and raceway except in unfinished spaces.

D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed to avoid damage to cables and to keep cables at

least 24 inches above ceiling tiles. Secure cable at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, or fittings.

E. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

F. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

G. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

H. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

I. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables to identify media in coordination with system wiring diagrams.

J. Wall-Mounting Outlets: Flush mounted.

K. Floor-Mounting Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

L. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

M. Weatherproof Equipment: Install units that are mounted outdoors, in damp locations, or where exposed to weather consistent with requirements of weatherproof rating.

N. Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

3.3 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment locations. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 16, Section 16450, “Grounding.”

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installations, including connections. Report results in writing.

B. Operational Test: Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and freedom from noise and distortion.

C. Signal-to-Noise Ratio Test: Measure the ratio of signal-to-noise of complete system at normal gain settings, using the following procedure:
   1. Disconnect a microphone at the connector or jack closest to it and replace it in the circuit with a signal generator using a 1,000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure the ratio of signal to noise.
   2. Repeat test for each separately controlled zone of loudspeakers.
   3. Minimum acceptance ratio is 50 dB.

D. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1,000, 3,000, 8,000, and 12,000 Hz into each preamplifier channel. For each frequency, measure the distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.

E. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4,000 Hz. Use a sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

F. Power Output Test: Measure electrical power output of each power amplifier at normal gain setting at 50, 1,000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

G. Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Comply with testing requirements specified in Division 16, Section 16450, “Grounding.”

H. Retesting: Correct deficiencies, revising tap settings of speaker-line matching transformers where necessary to optimize volume and uniformity of sound levels, and retest. Prepare written record tests.

I. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

J. Schedule tests with at least seven days’ advance notice of test performance.

3.5 CLEANING

A. Clean all equipment with manufacturers’ recommended cleaning methods and materials.

3.6 PROTECTION

A. Provide protective covering for installed speakers and amplifiers until construction is complete. Prevent operation of amplifiers when covered.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment as specified below:
   1. Train Owners maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment.
   2. Review data in maintenance manuals. Refer to General and Supplementary Conditions, "Contract Closeout."
   3. Review data in maintenance manuals. Refer to General and Supplementary Conditions, "Operation and Maintenance Data."
   4. Schedule training with Construction Manager, with at least seven days' advance notice.

END OF SECTION 16726